

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

1. (Previously Presented) A random copolymer based on non-conjugated cyclic polyene comprising structural units originated from one or more α -olefins (A1) and originated from one or more non-conjugated cyclic polyenes (A2), the said random copolymer having characteristic features comprising:

a content of the structural unit(s) originated from the said one or more α -olefins (A1) in the range of 93 to 70 mole %,

a content of the structural units originated from the said one or more non-conjugated cyclic polyenes (A2) in the range of 7 to 30 mole %,

an intrinsic viscosity $[\eta]$, determined in decahydronaphthalene at 135°C, in the range of 0.01 to 20 dl/g,

a glass transition temperature (T_g) of -30°C to +40°C, and

an iodine value in the range of 50 to 150.

2. (Previously Presented) A random copolymer based on non-conjugated cyclic polyene comprising structural units originated from one or more α -olefins (A1), originated

from one or more non-conjugated cyclic polyenes (A2) and originated from one or more non-conjugated linear polyenes (A3), the said random copolymer having characteristic features comprising:

a content of the structural unit(s) originated from the said one or more α -olefins (A1) in the range of 97.9 to 55 mole %,

a content of the structural unit originated from the said one or more non-conjugated cyclic polyenes (A2) in the range of 2 to 30 mole %,

a content of the structural unit originated from the said one or more non-conjugated linear polyenes (A3) in the range from 0.1 to 15 mole %,

an intrinsic viscosity $[\eta]$, determined in decahydronaphthalene at 135°C, in the range of 0.01 to 20 dl/g,

a glass transition temperature (T_g) -30°C to +40°C, and

an iodine value in the range of 5 to 150.

3. (Original) The random copolymer as claimed in claim 1 or 2, wherein the structural unit(s) originated from one or more α -olefins (A1) comprise at least a structural unit originated from ethylene in which the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range from 100/0 to 1/99.

4. (Original) The random copolymer as claimed in claim 1 or 2, wherein the structural unit(s) originated from one or more α -olefins (A1) comprise at least a structural unit originated from ethylene in which the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range from 100/0 to 50/50.

Claims 5-6 (Canceled)

7. (Previously Presented) A rubber composition comprising

- (A) a random copolymer based on non-conjugated cyclic polyene comprising structural units originated from one or more α -olefins (A1) and originated from one or more non-conjugated cyclic polyene (A2), the said random copolymer having characteristic features comprising:
- a content of the structural unit(s) originated from the said one or more α -olefins (A1) in the range of 93 to 70 mole %; a content of the structural unit originated from the said one or more non-conjugated cyclic polyenes (A2) in the range of 7 to 30 mole %; an intrinsic viscosity $[\eta]$, determined in decahydronaphthalene at 135°C, in the range of 0.01 to 20 dl/g; a glass transition temperature (TG) of -30°C to +40°C; and an iodine value in the range of 50 to 150, and
- (B) a rubber based on diene,

wherein the weight proportion of (the random copolymer based on non-conjugated cyclic polyene) versus (the rubber based on diene), namely, (A/(B), is in the range of 60/40 to 0.1/99.9.

8. (Previously Presented) A rubber composition comprising:

- (A) a random copolymer based on non-conjugated cyclic polyene comprising structural units originated from one or more α -olefins (A1) and originated from one or more non-conjugated cyclic polyenes (A2) and originated from one or more non-conjugated linear polyene (A3), the said random copolymer having characteristic features comprising:
- a content of the structural unit(s) originated from the said one or more α -olefins (A1) in the range of 97.9 to 55 mole %; a content of the structural unit originated from the said one or more non-conjugated cyclic polyenes (A2) in the range of 2 to 30 mole %; a content of the structural unit originated from the said one or more non-conjugated linear polyene (A3) in the range of 0.1 to 15 mole %; an intrinsic viscosity $[\eta]$, determined in decahydronaphthalene at 135°C, in the range of 0.01 to 20 dl/g; a glass transition temperature (T_g) of -30°C to +40°C; and an iodine value in the range of 5 to 150, and
- (B) a rubber based on diene,

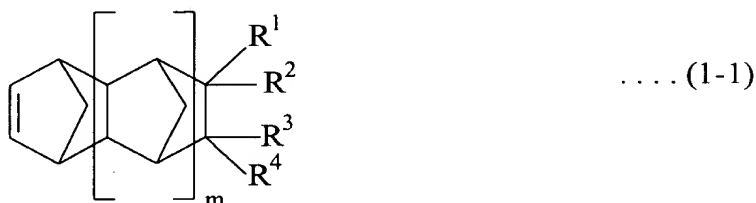
wherein the weight proportion of (the random copolymer based on non-conjugated cyclic polyene) versus (the rubber based on diene), namely, (A)/(B), is in the range from 60/40 to 0.1/99.9.

9. (Original) The rubber composition as claimed in claim 7 or 8, wherein the structural unit(s) originated from one or more α -olefins (A1) in the random copolymer based on non-conjugated cyclic polyene comprise at least a structural unit originated from ethylene, wherein the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range from 100/0 to 1/99.

10. (Original) The rubber composition as claimed in claim 7 or 8, wherein the structural unit(s) originated from one or more α -olefins (A1) in the random copolymer based on non-conjugated cyclic polyene comprise at least a structural unit originated from ethylene, wherein the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range from 100/0 to 50/50.

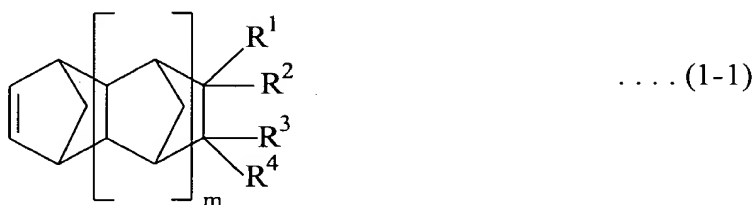
Claims 11-16 (Canceled)

17. (Previously Presented) The random copolymer as claimed in claim 1, wherein the non-conjugated cyclic polyene (A2) is that represented by the formula (1-1) given below:



in which m is an integer of 0 to 2, R^1 to R^4 denote each, independently of each other, an atom or a residue selected from the group consisting of hydrogen atom, halogen atoms and hydrocarbon residues which may have double bond, wherein R^1 to R^4 may be fused together to form a mono- or polycyclic ring which may have double bond or wherein an alkylidene radical may be formed from the pair of R^1 and R^2 or R^3 and R^4 or, further R^1 and R^3 or R^2 and R^4 may be fused together so as to form a double bond, with the proviso that at least one of R^1 to R^4 stands for an unsaturated hydrocarbon residue having at least one double bond, in case the mono- or polycyclic ring formed from R^1 to R^4 by being fused together has no double bond, in case the pair of R^1 and R^2 or R^3 and R^4 does not form an alkylidene radical and in case R^1 and R^3 or R^2 and R^4 are not fused together to form an endocyclic bond.

18. (Previously Presented) The random copolymer as claimed in claim 2, wherein the non-conjugated cyclic polyene (A2) is that represented by the formula (1-1) given below:



in which m is an integer of 0 to 2, R^1 to R^4 denote each, independently of each other, an atom or a residue selected from the group consisting of hydrogen atom, halogen atoms and hydrocarbon residues which may have double bond, wherein R^1 to R^4 may be fused together to form a mono- or polycyclic ring which may have double bond or wherein an alkylidene radical may be formed from the pair of R^1 and R^2 or R^3 and R^4 or, further, R^1 and R^3 or R^2 and R^4 may be fused together so as to form a double bond, with the proviso that at least one of R^1 to R^4 stands for an unsaturated hydrocarbon residue having at least one double bond, in case the mono- or polycyclic ring formed from R^1 to R^4 by being fused together has no double bond, in case the pair of R^1 and R^2 or R^3 and R^4 does not form an alkylidene radical and in case R^1 and R^3 or R^2 and R^4 are not fused together to form an endocyclic double bond.

19. (Previously Presented) The random copolymer as claimed in claim 17, wherein the structural unit(s) originated from one or more α -olefins (A1) comprise at least a

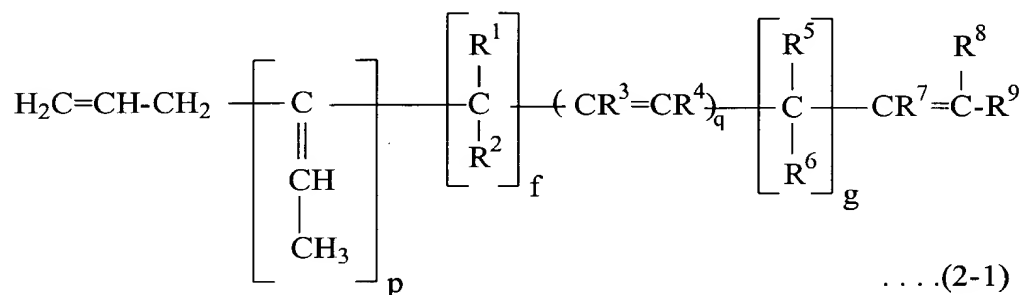
structural unit originated from ethylene in which the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range of from 100/0 to 1/99.

20. (Previously Presented) The random copolymer as claimed in claim 18, wherein the structural unit(s) originated from one or more α -olefins (A1) comprise at least a structural unit originated from ethylene in which the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range of from 100/0 to 1/99.

21. (Previously Presented) The random copolymer as claimed in claim 17, wherein the structural unit(s) originated from one or more α -olefins (A1) comprise at least a structural unit originated from ethylene in which the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range of from 100/0 to 50/50.

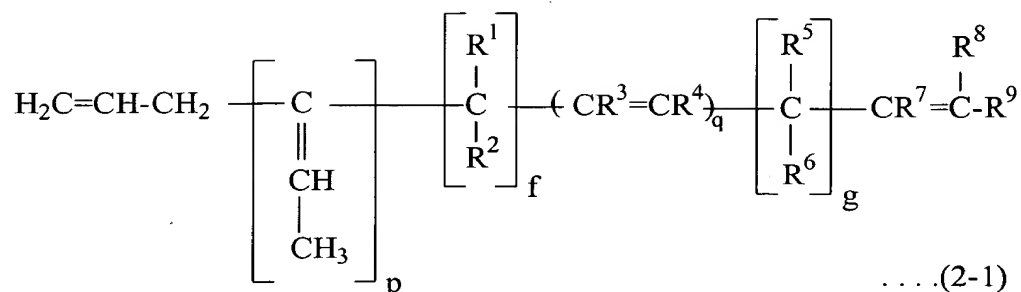
22. (Previously Presented) The random copolymer as claimed in claim 18, wherein the structural unit(s) originated from one or more α -olefins (A1) comprise at least a structural unit originated from ethylene in which the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range of from 100/0 to 50/50.

23. (Previously Presented) The random copolymer as claimed in claim 2, wherein the non-conjugated linear polyene (A3) is represented by the formula (2-1) given below:



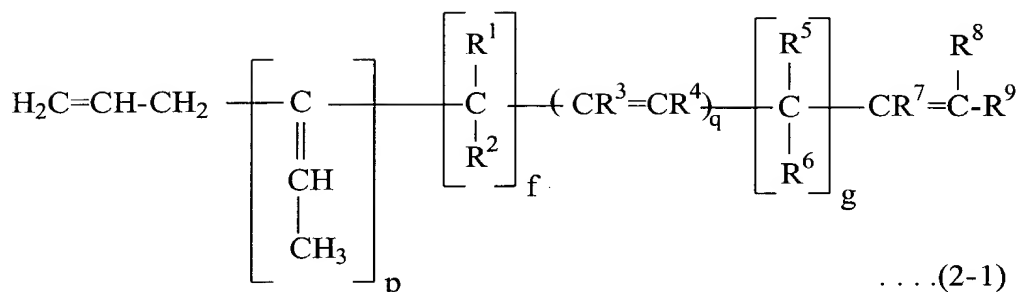
in which p and q is zero or 1 with the proviso that p and q are not zero simultaneously, f is an integer of zero to 5 with the proviso that f is not zero when both p and q are 1, g is an integer of 1 to 6, R¹, R², R³, R⁴, R⁵, R⁶ and R⁷ denote each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms, R⁸ denotes an alkyl group having 1-3 carbon atoms and R⁹ denotes hydrogen atom, an alkyl group having 1-3 carbon atoms or a group represented by $-(\text{CH}_2)_n-\text{CR}^{10}=\text{C}(\text{R}^{11})\text{R}^{12}$ in which n is an integer of 1 to 5, R¹⁰ and R¹¹ represent each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms and R¹² represents an alkyl group having 1-3 carbon atoms, with the proviso that R⁹ is hydrogen atom or an alkyl group having 1-3 carbon atoms when both p and q are 1.

24. (Currently Amended) The random copolymer as claimed in claim 18, wherein the non-conjugated linear polyene (A3) is represented by the formula (2-1) given below:



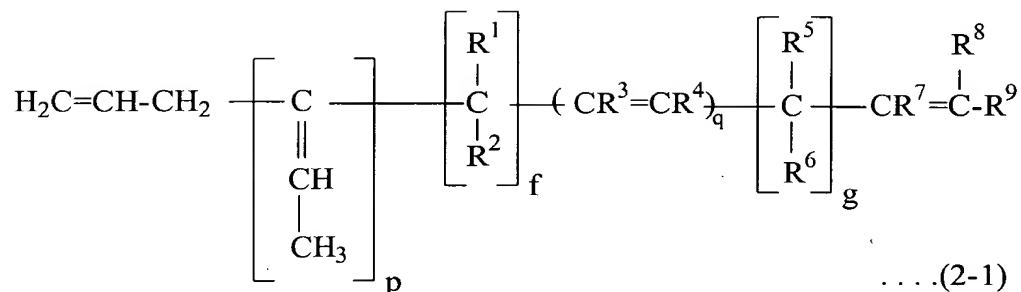
in which p and q is zero or 1 with the proviso that p and q are not zero simultaneously, f is an integer of zero to 5 with the proviso that f is not zero when both p and q are 1, g is an integer of 1 to 6, R¹, R², R³, R⁴, R⁵, R⁶ and R⁷ denote each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms, R⁸ denotes an alkyl group having 1-3 carbon atoms and R⁹ denotes hydrogen atom, an alkyl group having 1-3 carbon atoms or a group represented by $-(\text{CH}_2)_n-\text{CR}^{10}=\text{C}(\text{R}^{11})\text{R}^{12}$ in which n is an integer of 1 to 5, R¹⁰ and R¹¹ represent each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms and R¹² represents an alkyl group having 1-3 carbon atoms, with the proviso that R⁹ is hydrogen atom or an alkyl group having 1-3 carbon atoms when both p and q are 1.

25. (Previously Presented) The random copolymer as claimed in claim 20, wherein the non-conjugated linear polyene (A3) is represented by the formula (2-1) given below:



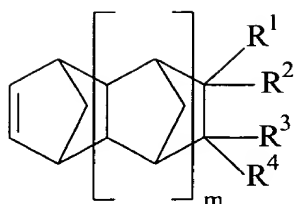
in which p and q is zero or 1 with the proviso that p and q are not zero simultaneously, f is an integer of zero to 5 with the proviso that f is not zero when both p and q are 1, g is an integer of 1 to 6, R¹, R², R³, R⁴, R⁵, R⁶ and R⁷ denote each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms, R⁸ denotes an alkyl group having 1-3 carbon atoms and R⁹ denotes hydrogen atom, an alkyl group having 1-3 carbon atoms or a group represented by $-(\text{CH}_2)_n-\text{CR}^{10}=\text{C}(\text{R}^{11})\text{R}^{12}$ in which n is an integer of 1 to 5, R¹⁰ and R¹¹ represent each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms and R¹² represents an alkyl group having 1-3 carbon atoms, with the proviso that R⁹ is hydrogen atom or an alkyl group having 1-3 carbon atoms when both p and q are 1.

26. (Previously Presented) The random copolymer as claimed in claim 22, wherein the non-conjugated linear polyene (A3) is represented by the formula (2-1) given below:



in which p and q is zero or 1 with the proviso that p and q are not zero simultaneously, f is an integer of zero to 5 with the proviso that f is not zero when both p and q are 1, g is an integer of 1 to 6, R¹, R², R³, R⁴, R⁵, R⁶ and R⁷ denote each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms, R⁸ denotes an alkyl group having 1-3 carbon atoms and R⁹ denotes hydrogen atom, an alkyl group having 1-3 carbon atoms or a group represented by $-(\text{CH}_2)_n-\text{CR}^{10}=\text{C}(\text{R}^{11})\text{R}^{12}$ in which n is an integer of 1 to 5, R¹⁰ and R¹¹ represent each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms and R¹² represents an alkyl group having 1-3 carbon atoms, with the proviso that R⁹ is hydrogen atom or an alkyl group having 1-3 carbon atoms when both p and q are 1.

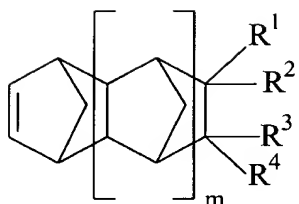
27. (Previously Presented) The rubber composition as claimed in claim 7, wherein the non-conjugated cyclic polyene (A2) is that represented by the formula (1-1) given below:



.... (1-1)

in which m is an integer of 0 to 2, R^1 to R^4 denote each, independently of each other, an atom or a residue selected from the group consisting of hydrogen atom, halogen atoms and hydrocarbon residues which may have double bond, wherein R^1 to R^4 may be fused together to form a mono- or polycyclic ring which may have double bond or wherein an alkylidene radical may be formed from the pair of R^1 and R^2 or R^3 and R^4 or, further, R^1 and R^3 or R^2 and R^4 may be fused together so as to form a double bond, with the proviso that at least one of R^1 to R^4 stands for an unsaturated hydrocarbon residue having at least one double bond, in case the mono- or polycyclic ring formed from R^1 to R^4 by being fused together has no double bond, in case the pair of R^1 and R^2 or R^3 and R^4 does not form an alkylidene radical and in case R^1 and R^3 or R^2 and R^4 are not fused together to form an endocyclic double bond.

28. (Previously Presented) The rubber composition as claimed in claim 8, wherein the non-conjugated cyclic polyene (A2) is that represented by the formula (1-1) given below:



. . . . (1-1)

in which m is an integer of 0 to 2, R^1 to R^4 denote each, independently of each other, an atom or a residue selected from the group consisting of hydrogen atom, halogen atoms and hydrocarbon residues which may have double bond, wherein R^1 to R^4 may be fused together to form a mono- or polycyclic ring which may have double bond or wherein an alkylidene radical may be formed from the pair of R^1 and R^2 or R^3 and R^4 or, further, R^1 and R^3 or R^2 and R^4 may be fused together so as to form a double bond, with the proviso that at least one of R^1 to R^4 stands for an unsaturated hydrocarbon residue having at least one double bond, in case the mono- or polycyclic ring formed from R^1 to R^4 by being fused together has no double bond, in case the pair of R^1 and R^2 or R^3 and R^4 does not form an alkylidene radical and in case R^1 and R^3 or R^2 and R^4 are not fused together to form an endocyclic double bond.

29. (Previously Presented) The rubber composition as claimed in claim 27, wherein the structural unit(s) originated from one or more α -olefins (A1) in the random copolymer based on non-conjugated cyclic polyene comprise at least a structural unit originated from ethylene, wherein the mole ratio of (the structural unit originated from ethylene) versus (the

structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range of from 100/0 to 1/99.

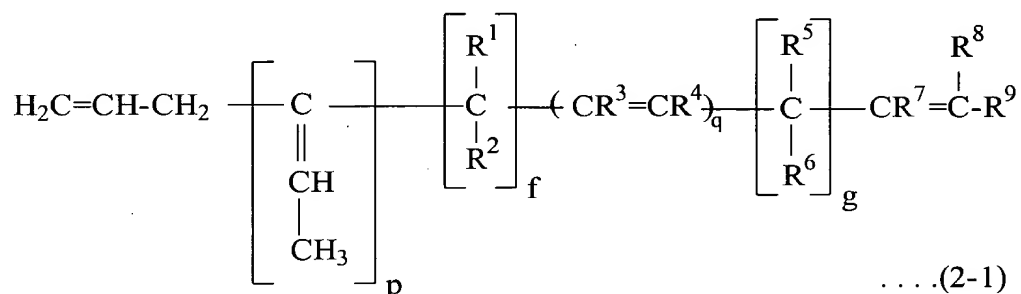
30. (Previously Presented) The rubber composition as claimed in claim 28, wherein the structural unit(s) originated from one or more α -olefins (A1) in the random copolymer based on non-conjugated cyclic polyene comprise at least a structural unit originated from ethylene, wherein the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range of from 100/0 to 1/99.

31. (Previously Presented) The rubber composition as claimed in claim 27, wherein the structural unit(s) originated from one or more α -olefins (A1) in the random copolymer based on non-conjugated cyclic polyene comprise at least a structural unit originated from ethylene, wherein the mole ratio of (the structural unit originated from ethylene) versus (the structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range of from 100/0 to 50/50.

32. (Previously Presented) The rubber composition as claimed in claim 28, wherein the structural unit(s) originated from one or more α -olefins (A1) in the random copolymer based on non-conjugated cyclic polyene comprise at least a structural unit originated from ethylene, wherein the mole ratio of (the structural unit originated from ethylene) versus (the

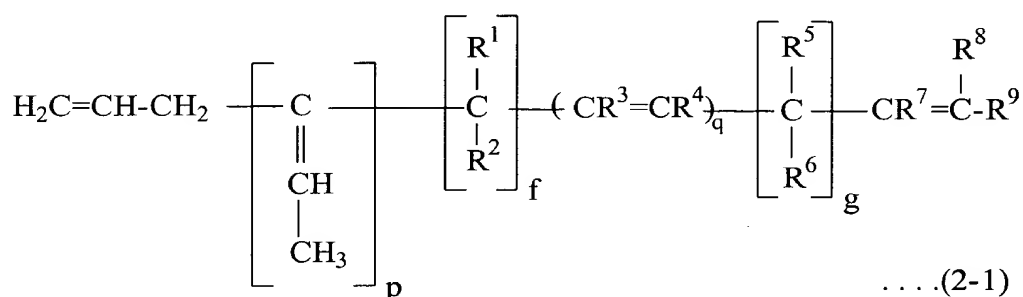
structural unit(s) originated from other α -olefin(s) having 3 or more carbon atoms) is in the range of from 100/0 to 50/50.

33. (Currently Amended) The rubber composition as claimed in claim 8, wherein the non-conjugated linear polyene (A3) is represented by the formula (2-1) given below:



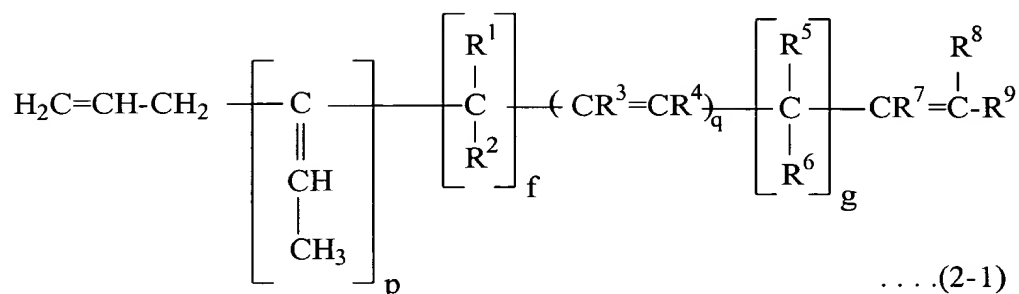
in which p and q is zero or 1 with the proviso that p and q are not zero simultaneously, f is an integer of zero to 5 with the proviso that f is not zero when both p and q are 1, g is an integer of 1, to 6, R^1 , R^2 , R^3 , R^4 , R^5 , R^6 and R^7 denote each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms, R^8 denotes an alkyl group having 1-3 carbon atoms and R^9 denotes hydrogen atom, an alkyl group having 1-3 carbon atoms or a group represented by $-(\text{CH}_2)_n-\text{CR}^{10}=\text{C}(\text{R}^{11})\text{R}^{12}$ in which n is an integer of 1 to 5, R^{10} and R^{11} represent each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms and R^{12} represents an alkyl group having 1-3 carbon atoms, with the proviso that R^9 is hydrogen atom or an alkyl group having 1-3 carbon atoms when both p and q are 1.

34. (Previously Presented) The rubber composition as claimed in claim 28, wherein the non-conjugated linear polyene (A3) is represented by the formula (2-1) given below:



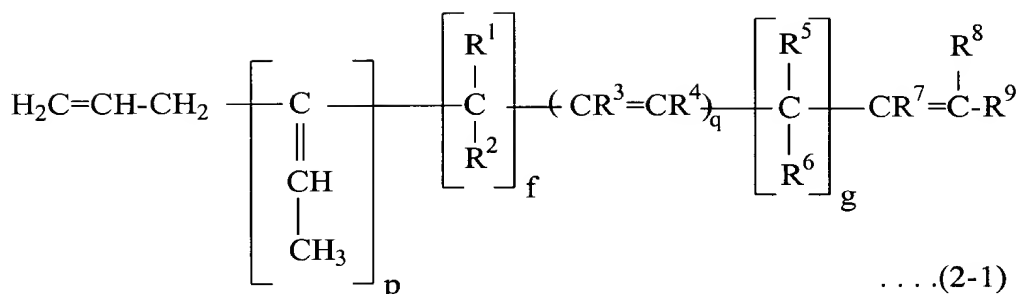
in which p and q is zero or 1 with the proviso that p and q are not zero simultaneously, f is an integer of zero to 5 with the proviso that f is not zero when both p and q are 1, g is an integer of 1 to 6, R¹, R², R³, R⁴, R⁵, R⁶ and R⁷ denote each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms, R⁸ denotes an alkyl group having 1-3 carbon atoms and R⁹ denotes hydrogen atom, an alkyl group having 1-3 carbon atoms or a group represented by $-(\text{CH}_2)_n-\text{CR}^{10}=\text{C}(\text{R}^{11})\text{R}^{12}$ in which n is an integer of 1 to 5, R¹⁰ and R¹¹ represent each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms and R¹² represents an alkyl group having 1-3 carbon atoms, with the proviso that R⁹ is hydrogen atom or an alkyl group having 1-3 carbon atoms when both p and q are 1.

35. (Previously Presented) The rubber composition as claimed in claim 30, wherein the non-conjugated linear polyene (A3) is represented by the formula (2-1) given below:



in which p and q is zero or 1 with the proviso that p and q are not zero simultaneously, f is an integer of zero to 5 with the proviso that f is not zero when both p and q are 1, g is an integer of 1 to 6, R¹, R², R³, R⁴, R⁵, R⁶ and R⁷ denote each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms, R⁸ denotes an alkyl group having 1-3 carbon atoms and R⁹ denotes hydrogen atom, an alkyl group having 1-3 carbon atoms or a group represented by $-(\text{CH}_2)_n-\text{CR}^{10}=\text{C}(\text{R}^{11})\text{R}^{12}$ in which n is an integer of 1 to 5, R¹⁰ and R¹¹ represent each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms and R¹² represents an alkyl group having 1-3 carbon atoms, with the proviso that R⁹ is hydrogen atom or an alkyl group having 1-3 carbon atoms when both p and q are 1.

36. (Previously Presented) The rubber composition as claimed in claim 32, wherein the non-conjugated linear polyene (A3) is represented by the formula (2-1) given below:



in which p and q is zero or 1 with the proviso that p and q are not zero simultaneously, f is an integer of zero to 5 with the proviso that f is not zero when both p and q are 1, g is an integer of 1 to 6, R¹, R², R³, R⁴, R⁵, R⁶ and R⁷ denote each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms, R⁸ denotes an alkyl group having 1-3 carbon atoms and R⁹ denotes hydrogen atom, an alkyl group having 1-3 carbon atoms or a group represented by $-(\text{CH}_2)_n-\text{CR}^{10}=\text{C}(\text{R}^{11})\text{R}^{12}$ in which n is an integer of 1 to 5, R¹⁰ and R¹¹ represent each, independently of each other, hydrogen atom or an alkyl group having 1-3 carbon atoms and R¹² represents an alkyl group having 1-3 carbon atoms, with the proviso that R⁹ is hydrogen atom or an alkyl group having 1-3 carbon atoms when both p and q are 1.

37. (Previously Presented) A rubber material for tires, comprising the random copolymer based on non-conjugated cyclic polyene as claimed in any one of claims 1, 2, 17, 18 or 23.

38. (Previously Presented) A rubber material for tires, comprising the rubber composition as claimed in any one of claims 7, 8, 27, 28 or 33.

39. (Previously Presented) A tire tread produced from the rubber material for tires as claimed in claim 37.

40. (Previously Presented) A tire tread produced from the rubber material for tires as claimed in claim 38.

41. (Previously Presented) A tire which has a tire tread as claimed in claim 39.

42. (Previously Presented) A tire which has a tire tread as claimed in claim 40.